

FORM PTO-1390
(REV 11-98)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATE
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

57,0291 US PCT

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)

09/622454

INTERNATIONAL APPLICATION NO
PCT/GB99/00298INTERNATIONAL FILING DATE
28 January 1999PRIORITY DATE CLAIMED
17 February 1998

TITLE OF INVENTION Anti-accretion additives for drilling fluids

APPLICANT(S) FOR DO/EO/US Louise Bailey and Boyd Grover

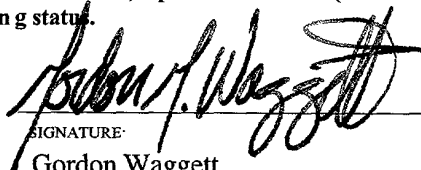
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1)
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(3)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☐ Other items or information:

534 Rec'd PCT/PTO 16 AUG 2000

U.S. APPLICATION NO. (known to USPTO) 09/622454		INTERNATIONAL APPLICATION NO. PCT/GB99/00298		ATTORNEY'S DOCKET NUMBER 57.0291 US PCT	
17. <input checked="" type="checkbox"/> The following fees are submitted BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) : Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$970.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO. \$840.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$760.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$670.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) \$96.00 ENTER APPROPRIATE BASIC FEE AMOUNT =				CALCULATIONS PTO USE ONLY	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	17 - 20 =	-0-	X \$18.00	\$ -	
Independent claims	2 - 3 =	-0-	X \$78.00	\$ -	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$260.00	\$	
TOTAL OF ABOVE CALCULATIONS =				\$ 840.00	
Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28).				\$	
SUBTOTAL =				\$	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
TOTAL NATIONAL FEE =				\$ 840.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				+	
TOTAL FEES ENCLOSED =				\$ 840.00	
				Amount to be:	\$
				refunded	\$
				charged	\$
a. <input type="checkbox"/> A check in the amount of \$_____ to cover the above fees is enclosed.					
b. <input checked="" type="checkbox"/> Please charge my Deposit Account No. <u>04-1579</u> in the amount of \$ <u>840.00</u> to cover the above fees. A duplicate copy of this sheet is enclosed.					
c. <input type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>04-1579</u> . A duplicate copy of this sheet is enclosed.					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO: Schlumberger Technology Corporation 110 Schlumberger Drive, MD1 Sugar Land TX 77478 USA					
				SIGNATURE:  Gordon Waggett	
				NAME 34,476	
				REGISTRATION NUMBER	

09/622454
PATENT

ATTORNEY DOCKET NO. 57.0291
EXPRESS MAIL NO. EK802769773US

534 Rec'd PCT/PTO 16 AUG 2000

"EXPRESS MAIL" MAILING LABEL
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I HEREBY CERTIFY THAT THIS PAPER OR FEE IS BEING DEPOSITED
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Tricia Van Hooser
(typed or printed name of person mailing paper or fee)
Tricia E van Hooser
(signature of person mailing paper or fee)

UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)

In re Application of:)	Attorney Docket N ^o : 57.0291
Louise Bailey)	
Boyd Grover)	
)	
Serial No.: Unknown)	Group Art Unit: Unknown
)	
Filed: Herewith)	
)	
For: ANTI-ACCRETION ADDITIVES)	Examiner: Unknown
FOR DRILLING FLUIDS)	
)	

PRELIMINARY AMENDMENT

Box PCT
Assistant Commissioner for Patents
Washington, D.C. 20231

Sir

Prior to calculating the fee due for the above-identified application and prior to the first Office Action, please amend the above-identified application, as follows:

IN THE CLAIMS

Before claim 1, insert -- What is claimed is: --

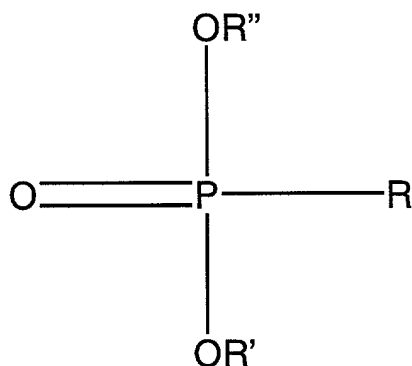
Please cancel claims 1-8.

Please amend the following claims:

In claim 15, before "of preventing accretion", delete "Method" and insert -- A method--.

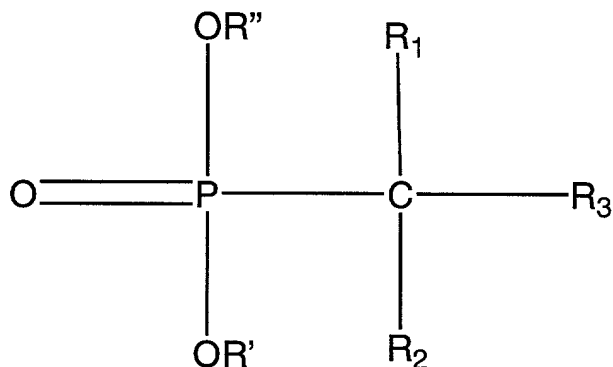
Please add the following claims:

Claim 17. A drilling fluid being water-based and having an inhibitive component to reduce the hydration of shale further comprising an additive in accordance with the formula



where R, R' and R'' are groups of non-polymeric character.

Claim 18. The drilling fluid of claim 17, comprising an additive in accordance with the formula



where R1, R2 and R3 are groups of non-polymeric character.

Claim 19. The drilling fluid of claim 17, wherein the additive is based on a phosphor derivative of the succinic acid.

Claim 20. The drilling fluid of claim 17, wherein the additive is based on a short chain phosphorylated hydrocarbon.

Claim 21. The drilling fluid of claim 17, comprising the additive in a concentration of up to about 10% weight by volume.

Claim 22. The drilling fluid of claim 17, being a reactive anionic drilling fluid.

Claim 23. The drilling fluid of claim 17, being a phosphate-based drilling fluid.

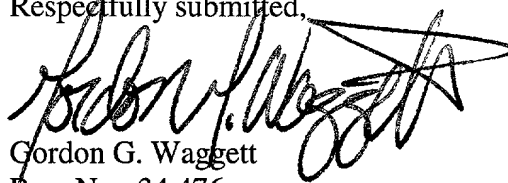
Claim 24. The drilling fluid of claim 21, being a silicate-based drilling fluid.

Claim 25. A method of preventing accretion of cuttings in a borehole, said method comprising the step of using a drilling fluid in accordance with claim 17 during a drilling operation.

REMARKS

The above amendments do not add any new matter. Favorable consideration of this application is requested. Please do not hesitate to contact the undersigned by phone for prompt resolution of any outstanding issues. It is believed that no fee is due for this Preliminary Amendment, however, if such a fee is due, the Commissioner is authorized to charge such fee, or credit overpayment, to Deposit Account No. 04-1579(57.0291).

Respectfully submitted,


Gordon G. Waggett
Reg. No.: 34,476
Attorney for Applicant(s)

Date: 16 August 00

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Anti-accretion additives for drilling fluids

This invention relates to anti-accretion additives for drilling
5 muds.

BACKGROUND OF THE INVENTION

Bit-balling and cuttings accretion are problems encountered when
10 drilling shales, particularly with water-based muds. Shale
cuttings can adhere to each other and to the bottom hole
assembly and cutting surfaces of the bit. Gradually a large
plastic mass builds up which can block mud circulation and
reduce rates of penetration. There is a "danger zone" of clay
15 plasticity for balling and accretion, related to the water
content of the clay or shale, which can be defined in terms of
the Atterberg limits of soil mechanics. In the dry zone the clay
has too little water to stick together and it is a friable and
brittle solid. In the wet zone the material is essentially
20 liquid like with very little inherent strength and can be washed
away.- Intermediate to these zones, i.e., in the danger zone,
the shale is a sticky plastic solid with greatly increased
agglomeration properties and inherent strength.

25 When cuttings are exposed to conventional water-based muds they
usually imbibe water and pass rapidly through these different
zones, eventually dispersing. However recent advances in
drilling fluid technology have developed highly inhibitive muds
which appear to reduce the hydration of shale and in doing so
30 maintain the cuttings in the danger or plastic zone contributing
to increased accretion and bit-balling. Field experiences with
glycol, phosphate and silicate muds in particular have shown
accretion problems.

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US patent 5,639,715 describes additives for bit-balling prevention based on sulphonosuccinate chemistry.

Phosphorus based additives and compound have been used in the oilfield industry mainly for the purpose of enhancing oil recovery from production wells.

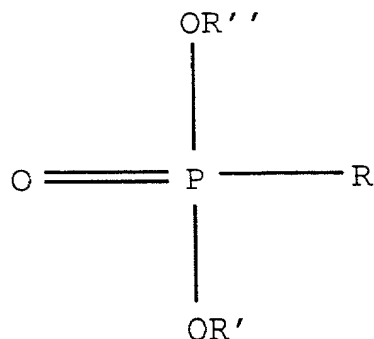
It is the object of the present invention to find alternatives to the known methods of preventing accretion.

10

SUMMARY OF THE INVENTION

The invention is an additive for drilling mud. The additive reduces the accretion and bit-balling tendencies of cuttings exposed to said muds. The additives are based on phosphonate chemistry, and are preferably of the general class:

(I)



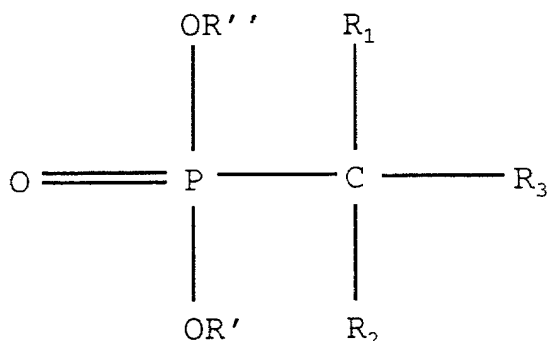
20

wherein R, R' and R'' are radicals exclusively containing H atoms or combinations of H, C, O or P atoms up to a maximum of 100 atoms.

In a more preferred embodiment, the additives are based on the formula

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(II)



wherein R_1 , R_2 and R_3 are radicals exclusively containing H atoms
 5 or combinations of H, C, O or P atoms up to a maximum of 100 atoms.

In a preferred embodiment of the invention, the additives are
 containing not more than one phosphor atom.

10

In another preferred embodiment of the invention, the additive
 is a phosphor derivative of the succinic acid or short chain
 phosphorylated hydrocarbons.

15 Additives according to the invention are added to the drilling
 fluid at levels 0.1-10%, preferably 1-5%, weight by volume
 (%kg/liter). The drilling fluid itself may be oil based, though
 it is recognized that accretion tends to be less pronounced in
 drilling muds of this kind. Therefore, the preferred drilling
 20 fluid in accordance with the present invention is water based,
 even more preferably a reactive anionic based drilling fluid,
 such as silicate or phosphate based muds. Further additives as
 known in the art may be added to impart other desired properties
 to the mud system. Such known additives include viscosifying
 25 agents, filtrate reducing agent, and weight adjusting agents.
 Other preferred additives are shale-swelling inhibitors, such as
 salts glycol-, silicate- or phosphate-based agents, or any
 combination thereof.

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These and other features of the invention, preferred embodiments and variants thereof, and further advantages of the invention will become appreciated and understood by those skilled in the art from the detailed description below.

5

MODE(S) FOR CARRYING OUT THE INVENTION

A test used to determine the anti-accretion properties of additives involves squeezing shale or clay cuttings between two
10 steel plates with a given force causing them to stick to each other and the plates. The force required to slide the plates apart is then determined using a force gauge or spring balance.

Oxford clay cuttings of size 2-4mm were soaked in the test fluid
15 for 15 minutes. The excess mud was drained from the cuttings using a sieve (500 micron mesh). A small pile of cuttings (5-10g) was put onto the base plate of the tester. The pile was roughly levelled and the top plate replaced over the cuttings. A PTFE spacer was placed on top of the top plate. A screw-mounted
20 plunger in the tester housing was wound down until it made contact with the spacer. A torque wrench was used to tighten the plunger onto the top plate. The standard torque was 75 inch-pounds (~9N.m). Immediately on reaching this value, the plunger was wound back sufficiently to remove the spacer. A force gauge
25 or spring balance was then connected to the top plate. The tension on the top plate was then increased by pulling on the force gauge until the plate breaks free from the cuttings bed. The maximum force recorded was the freeing force for the plate or accretion value. Values can range from 1.0 to above 20.0 kg
30 force.

The phosphonate based additives tested in accordance with the above procedure are added to a water-based mud containing tetrapotassium pyrophosphate (TKPP) and consisting of
35 1000 ml fresh water (base)

- 5 -

85.5 g tetrapotassium pyrophosphate (shale inhibitor)
2.85 g xanthan gum (viscosifier)
11.4 g carboxy methyl cellulose of low viscosity grade
(filtrate reducer)
42.75 g simulated drill solids
barite (weighting agent) to density 1.08 sg .
NaOH to pH 9.2
biocide

10 Baseline accretion values were established as:

Simple polymer mud	5 kg
TKPP mud	21.7 kg

15 The anti-accretion additives were then added to the TKPP mud at levels of 1-5%.

Additives which reduced the accretion value from >10 kg to 9 kg or below were:

20

- Hydrolysed polymaleic acid
- 3-phosphonopropionic acid
- succinic acid
- propyl phosphonic acid

25

- dibutyl-butyl phosphonate
- hydroxyphosphonoacetic acid
- dimethylpropyl phosphonate
- phosphorous acid

30

- ethylmethacrylate phosphate
- tri-ethyl phosphonoacetate
- tetramethyl phosphonosuccinate
- phosphonosuccinic acid
- 2-hydroxyethyl phosphonic acid.

35

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The last five additives (Additives 9-14) were the found most effective. For those the following values were recorded:

	<u>TKPP mud + (%)additive:</u>	<u>Accretion value</u>
5	1% diethyl-ethylphosphonate	8 kg
	5% diethyl-ethylphosphonate	7 kg
	5% ethylmethacrylate phosphate	6 kg
	1% tri-ethyl phosphonoacetate	8 kg
10	5% tri-ethyl phosphonoacetate	5 kg
	5% tetramethyl phosphonosuccinate	7 kg
	5% phosphonosuccinic acid	7 kg
	5% 2-hydroxyethyl phosphonic acid.	7 kg

15

In a second series of tests with the additives, silicate mud of the following composition was used:

- 1000 ml sea water (base)
- 20 131 g Na silicate, a solution of 14% NaOH and 27% SiO₂ (shale inhibitor)
- 117.5 g KCl (shale inhibitor, weighting agent)
- 20 g Polyanionic cellulose (filtrate reducer)
- 5 g Xanthan gum (viscosifier)
- 25 NaOH to adjust pH to 12.

Baseline accretion values were established as:

	simple polymer mud	9.5 kg
30	silicate mud	17.7 kg

The anti-accretion additives were tested in the silicate mud at 1% (w/v):

35

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Silicate mud + (1%)additive:Accretion value

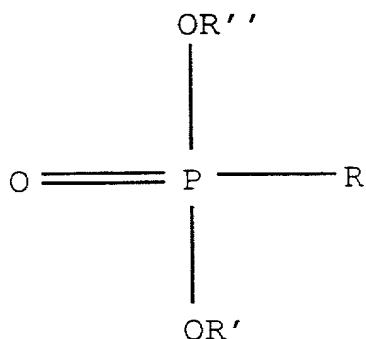
	diethyl-ethylphosphonate	11.1 kg
	tri-ethyl phosphonoacetate	11.35 kg
5	tetramethyl phosphonosuccinate	9.96 kg
	phosphonosuccinic acid	10.8 kg
	2-hydroxyethyl phosphonic acid	11.4 kg

In most cases the accretion value has been reduced
10 significantly, down to the levels of a simple polymer mud.

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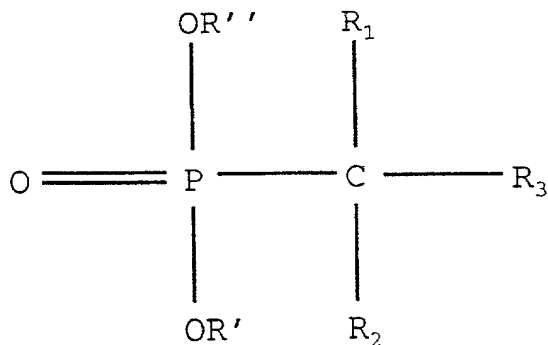
CLAIMS

1. Additive for a drilling fluid, consisting of a compound in accordance with the formula



wherein R, R' and R'' are radicals exclusively containing H atoms or combinations of H, C, O or P atoms up to a maximum of 100 atoms.

2. The additive of claim 1, wherein R, R' and R'' are radicals exclusively containing H atoms or combinations of H, C or O.
3. The additive of claim 1, consisting of a compound in accordance with the formula



wherein R₁, R₂ and R₃ are radicals exclusively containing H atoms or combinations of H, C, O or P atoms up to a maximum of 100 atoms.

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4. The additive of claim 3, wherein R_1 , R_2 and R_3 are radicals exclusively containing H atoms or combinations of H, C or O.

5. The additive of claim 1, based on a phosphor derivative of the succinic acid.

6. The additive of claim 1, based on a short chain phosphorylated hydrocarbon.

10

7. Drilling fluid comprising an additive in accordance with claim 1.

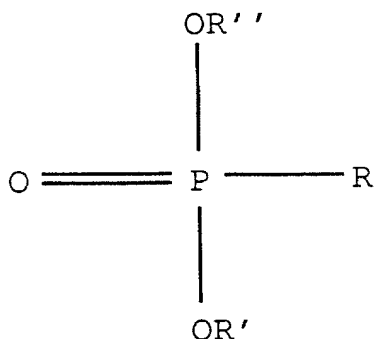
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8. The drilling fluid of claim 5, comprising an additive in accordance with claim 1 in a concentration of up to about 10% weight by volume.

20

9. A drilling fluid comprising
water as base component;
a viscosifying agent to increase the viscosity of the fluid;
a filtrate reducing agent;
a weighting agent to adjust the density of the fluid; and
an additive for a drilling fluid, consisting of a compound in
accordance with the formula

25



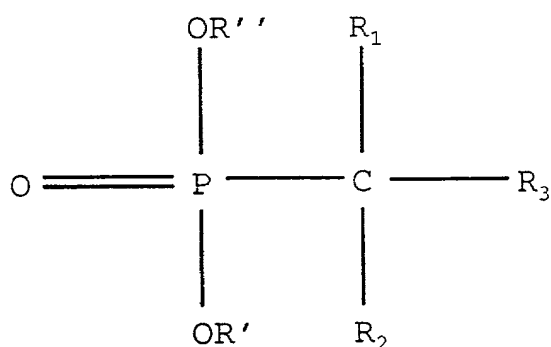
wherein R, R' and R'' are radicals exclusively containing H atoms or combinations of H, C, O or P atoms up to a maximum of 100 atoms.

- 10 -

10. The drilling fluid of claim 9, wherein R, R' and R'' are radicals exclusively containing H atoms or combinations of H, C or O.

5

11. The drilling fluid of claim 9, wherein the additive consists of a compound in accordance with the formula



10

wherein R₁, R₂ and R₃ are radicals exclusively containing H atoms or combinations of H, C, O or P atoms up to a maximum of 100 atoms.

15

12. The drilling fluid of claim 11, wherein R₁, R₂ and R₃ are radicals exclusively containing H atoms or combinations of H, C or O.

- 20 13. The drilling fluid of claim 9, further comprising a shale swelling inhibition agent.

14. The drilling fluid of claim 13, wherein the shale swelling inhibition agent comprises phosphate- or silicate-based compounds.

25

15. Method of preventing accretion of cuttings in a borehole, said method comprising the step of adding to a drilling fluid

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an additive in accordance with claim 1 prior to or during a drilling operation.

16. The method of claim 15, wherein the additive is added in a
5 concentration of up to about 10% weight by volume of the
drilling fluid.

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Based on PTO/SB/01 (3/97)
Approved for use through 9/30/98. OMB 0651-0032
Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

DECLARATION FOR PATENT APPLICATION

☒ Declaration Submitted **WITH** Initial Filing **OR** ☒ Declaration Submitted **After** Initial Filing

Attorney Docket Number:

57.0291

First-Named Inventor:

Louise Bailey

COMPLETE IF KNOWN:

Application Number:

09/622,454

Filing Date:

August 16, 2000

Group Art Unit:

Examiner's Name:

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

ANTI-ACCRETION ADDITIVES FOR DRILLING FLUIDS

the specification of which:

☐ is attached hereto as Attorney Docket No.: 57.0291

OR

☒ was filed on August 16, 2000 ☒ as United States Application No. 09/622,454 or

☐ PCT International Application No. _____

☐ and was amended on _____ (MMDDYY).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 1.19(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application Numbers	Country	Foreign Filing Date (MMDDYY)	Priority Not Claimed	Certified Copy Attached?	
				Yes	No
PCT/GB99/00298	WO	JAN 28, 1999		<input type="checkbox"/>	<input checked="" type="checkbox"/>
9803249.3	GB	FEB 17, 1998		<input type="checkbox"/>	<input checked="" type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>

☐ Additional foreign application numbers are listed in a supplemental priority data sheet PTO/SB/02B, attached hereto.

Please type a + sign inside this box ☐

Based on PTO/SB/01 (3/97)
Approved for use through 9/30/98. OMB 0651-0032
Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

☐ I hereby claim the benefit under Title 35 U.S.C. § 1.19(e) of any United States provisional application(s) listed below.

Application Number	Filing Date

☐ Additional provisional patent application numbers are listed in a supplemental priority data sheet PTO/SB/02B, attached hereto.

I hereby claim the benefit under 35 U.S.C. § 1.20 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph 35 of U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

US Parent Application Number	PCT Parent Number	Parent Filing Date (MMDDYY)	Parent Patent Number (if applicable)
---------------------------------	-------------------	--------------------------------	---

☐ Additional US or PCT international application numbers are listed in a supplemental priority data sheet PTO/SB/02B, attached hereto.

As a named inventor, I hereby appoint the following attorney(s) and/or agents(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

Name	Registration Number	Name	Registration Number
Maryam Bani-Jamali	<u>36,084</u>	Victor Segura	<u>44,329</u>
Gordon G. Waggett	<u>34,476</u>	J. H. Bouchard	<u>29,286</u>
Robin C. Nava	<u>42,926</u>	Wayne I. Kanak	<u>35,564</u>
John J. Ryberg	<u>31,134</u>	Jeffery E. Griffin	<u>36,534</u>
Steve Christian	<u>38,106</u>	Peter Y. Lee	<u>30,865</u>
Brigitte Jeffery	<u>38,925</u>	William L. Wang	<u>39,871</u>
Douglas Y'Barbo	<u>42,239</u>		

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information Sheet PTO/SB/02B, attached hereto.

I hereby direct that all correspondence and telephone calls be addressed to:

Name	Maryam Bani-Jamali		
Address	Schlumberger Technology Corporation		
Address	110 Schlumberger Drive, MD1		
City	Sugar Land	State	Texas
Country	U.S.A.	Telephone	281-285-4524
		Zip	77478
		Fax	281-285-8569

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the

Please type a + sign inside this box ☐

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Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Sole or first inventor:

Inventor's Full Name

Louise
(First)

(Initial)

Bailey
(Last)

Inventor's Signature:

Louise Bailey

Date: 3. 9. 00

Residence Street Address

58 The High Street, Yelling, St. Neots, Cambridgeshire PE19 4SO, United Kingdom

Country of Residence:

UK

Citizenship:

UK

Second inventor:

Inventor's Full Name

Boyd
(First)

(Initial)

Grover
(Last)

Inventor's Signature:

BW Grover

Date: 22/10/00

Residence Street Address

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Citizenship:

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